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The Digital Rebirth of Traditional Crafts: Research on Visual Translation and Product Innovation of Boxwood Carving Based on AIGC Technology

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Abstract: Against the dual background of intangible cultural heritage (ICH) activation and new consumption upgrading, Yueqing boxwood carving is trapped in developmental dilemmas such as product homogenization, outdated aesthetics, low digitalization level, and insufficient access to young audiences. The traditional manual development model can hardly meet the agile demands of the modern cultural and creative industry. To address this, this study innovatively constructs a four-dimensional closed-loop system of "Cultural Decoding—AIGC Translation—Creative Design—Industrial Empowerment". The core lies in transforming the implicit knowledge of traditional boxwood carving, such as the essence of knife techniques, modeling grammar, and cultural connotations, into visual elements that can be recognized and precisely controlled by AIGC technology. Through precise generation on the Nano Banana Pro platform, application of collaborative tools, combined with designers' secondary creation and industrial implementation transformation, a standardized "human-machine collaboration" design process is formed, and a series of innovative products are successfully developed. Practical verification shows that on the basis of adhering to cultural authenticity, this system not only significantly shortens the product R&D cycle and reduces trial-and-error costs, but also realizes the organic integration of traditional crafts and modern aesthetics, broadens the communication and sales channels. It provides a new path with both theoretical value and practical significance for the youthful expression, commercial transformation and sustainable development of ICH techniques.

Keywords: Boxwood Carving; Digitalization of Intangible Cultural Heritage; Innovation of Cultural and Creative Products; Traditional Crafts.

1. Current Situation, Problems and Significance of AIGC Empowering Boxwood Product Innovation

1.1. Research Background and Practical Dilemmas

In the dual context of "ICH activation" and "new consumption", the value realization of ICH products is shifting from static display to daily and digital fields. However, as a representative of traditional crafts, Yueqing boxwood carving is facing severe "dislocation" challenges. On the one hand, product homogenization and outdated aesthetics are prominent. The market is flooded with similar traditional statues, falling into the involution dilemma of "high craftsmanship but low creativity", which is difficult to meet the personalized demands of Generation Z. On the other hand, digital assets are weak and R&D costs are high. The traditional development model relying on manual experience has a long cycle and is difficult to test and error, which cannot adapt to the agile rhythm of "small-batch and quick-return" in modern cultural and creative industries. If it fails to complete the modern "translation" in visual language, this traditional craft will face the risk of being marginalized by the market.[1]

1.2. Opportunities and Core Issues Brought by AIGC Technology

With the advancement of AI technology, Nano Banana Pro has become a powerful assistant for ICH innovation. Compared with previous general models, its biggest advantage is that it "understands professional jargon"—it has a strong ability to understand Chinese and can accurately identify professional terms in the field of ICH, so designers no longer have to rack their brains to come up with complex instructions.[2]

This study aims to explore an effective path for AIGC technology to intervene in the development of boxwood carving cultural and creative products. The core is to answer three major questions: how to transform the implicit knowledge of boxwood carving into visual control elements recognizable by AIGC, how to construct a reproducible "human-machine collaboration" visual translation process and establish a boundary control mechanism between culture and innovation, and how to cross the gap from digital generation to physical implementation and verify the effect of industrial empowerment.[3]

Therefore, the research and practice on visual translation and product innovation of boxwood carving based on AIGC technology are reflected in three dimensions: constructing a standardized digital translation paradigm for ICH at the method level, expanding the full-link application boundary of AIGC at the application level, and establishing a multi-subject collaborative innovation path at the mechanism level. It provides a systematic methodology and replicable empirical basis for the digital transformation and industrial empowerment of ICH techniques.[4]

2. Research Ideas and Element Analysis

This study follows the logical line of "theoretical construction—element decomposition—path design—mechanism verification", aiming to realize the visual translation and modern productization of boxwood carving, a traditional ICH craft, through AIGC technology.

2.1. Selection of Research Objects and Resources

The accurate definition of research objects and the construction of datasets are the cornerstones of AIGC training. At the craft level, this study focuses on Yueqing boxwood carving, covering four major themes: gods and Buddhas, auspicious beasts, auspicious patterns and modern utensils. It focuses on analyzing the sense of volume of round carving, the spatial layering of openwork carving, and the unique delicate knife techniques and textures in the finishing process. To ensure data quality, the team has established a multi-modal ICH corpus including high-definition multi-angle finished product images, macro texture close-ups, process line drawings and pattern vector graphics. At the demand level, through market research, it anchors the consumption preference of Generation Z and the new middle class for "neo-Chinese style", and positions the application scenarios as youthful gifts, office stress-relief ornaments and home aesthetic furnishings, thereby reversely deriving the style logic of AIGC generation, ensuring that the output has both traditional heritage and conforms to contemporary market aesthetics.

2.2. Construction of Four-Dimensional Closed-Loop Framework

To address the pain points such as "difficulty in design implementation" and "long development cycle" in traditional ICH innovation, this study constructs a four-dimensional closed-loop framework of "Cultural Decoding—AIGC Translation—Creative Design—Industrial Empowerment". Firstly, as the logical starting point, cultural decoding aims to externalize the implicit "master craftsman's experience" of boxwood carving, clarify its aesthetic core and cultural taboos, and set clear generation boundaries for AI. Then it enters the core AIGC translation link, using the Nano Banana Pro platform to convert the extracted craft characteristics into computer-recognizable instructions, and with its built-in precise control functions, convert the abstract "boxwood charm" into controllable high-quality digital design drawings. To solve the problem that the generated images are "good-looking but hard to make", the creative design link introduces designers for secondary processing, combining physical materials and structural logic to convert 2D images into a complete product system including packaging and narration. Finally, as the foothold, industrial empowerment promotes the market-oriented implementation of products through multiple channels, and uses sales feedback data to feed back model fine-tuning, forming a virtuous ecological closed loop from generation to transformation and then to iteration.

2.3. Decomposition, Mapping and Principles of Key Elements

To ensure the generation accuracy of Nano Banana Pro, the study decomposes the visual characteristics of boxwood carving into three key machine-understandable control dimensions: structure control, material restoration and detail refinement. Through corresponding technical functions, it achieves dual guarantees of generation quality and style unity.

This study establishes a full-link collaborative mechanism of "inheritors—designers—enterprises—platforms", clarifies the responsibilities of each subject, and strictly adheres to three bottom lines: data right confirmation, cultural red lines and craft ethics, so as to ensure the cultural authenticity and industrial feasibility of ICH innovation assisted by AIGC.

3. Construction of Visual Translation and Product Innovation System

This study no longer regards AIGC as a single image generation tool, but as a core engine embedded in the full link of ICH activation, constructing a systematic visual translation and product innovation system.

3.1. Principles of System Construction

The construction of this system follows four core principles: first, adhering to cultural adaptability, taking the unique knife texture and theme genealogy of boxwood carving as the logical basis, avoiding generalized "national style pasting", and ensuring that visual generation is faithful to the ontological characteristics of "warmth and roundness"; second, emphasizing controllability and reproducibility, converting the randomness of AI generation into stable productivity with traceable parameters by constructing a standardized workflow and version management mechanism; third, following the principle of progressive capability, establishing a gradual path from 2D asset precipitation, 3D form deduction to engineering implementation, realizing the gradual amplification of the value chain; finally, establishing an implementation-oriented approach, ensuring that the output of each link corresponds to manufacturable entities or clear communication materials, and avoiding technical applications from being divorced from industrial reality.

3.2. Specific Design of Four Modules

Based on the above principles, this study divides the innovation system into four functional modules: "Cultural Decoding, AIGC Translation, Creative Design, Industrial Empowerment". Each module is interlocking, forming a complete closed loop from data collection to commercial transformation. The specific logic and elements are shown in Table 1.

3.3. Design of Evaluation System

To verify the system's effectiveness, this study constructs a multi-dimensional evaluation mechanism including authenticity, innovation and marketability. In the authenticity dimension, inheritors are introduced as "gatekeepers" to focus on examining the accuracy of process logic and cultural semantics and prevent technical misinterpretation. In the innovation dimension, the design team takes the lead to investigate visual differentiation, modern aesthetic integration and serial extension potential. In the marketability dimension, facing the industrial terminal, it takes into account the manufacturability and cost control on the supply side, as well as the willingness of young users and communication adaptability on the demand side, ensuring that the design results effectively cross the gap between "concept" and "physical object" and realize substantive industrial empowerment.

Table 1. Logical Elements of the Four Modules of "Cultural Decoding—AIGC Translation—Creative Design—Industrial Empowerment"

Module Name	Core Objectives	Methods and Tools	Key Outputs	Evaluation Dimensions
Module ACultural Decoding	Externalization of implicit knowledge Establishment of cultural boundaries	Methods: Field investigation, semi-structured interviews, literature reviewTools: Knowledge graph, semantic analysis tools	Core symbol library (patterns/modeling vector graphics) Semantic tag set (Prompt keyword list)	Completeness of data Accuracy of semantic extraction
Module BAIGC Translation	Digitization of visual languageGeneration of controllable schemes	Methods: Structure control (ControlNet), style injection (LoRA), local redrawingTools: Nano Banana Pro	Visual master version (material/pattern/composition specifications)Form draft (multi-view modeling schemes)	Generation quality (resolution/structure)Style restoration degree
Module CCreative Design	Productization of generated resultsConstruction of system experience	Methods: Serial combination, modular design, CMF engineering transformationTools: 3D modeling software (Rhino/ZBrush), graphic design software	Product series schemes (3D models/engineering drawings)Packaging and narrative system (visual identification/instruction manual)	Design completenessSerial logic
Module DIndustrial Empowerment	Commercial implementation of achievementsExpansion of communication fields	Methods: Scene application implantation, cross-border co-branding, digital exhibition planningTools: Virtual exhibition hall technology, new media distribution matrix	Shelf materials (detail pages/promotional pictures)Digital exhibition contentCo-branding/channel proposals	Channel matching degreeCommunication data feedback

4. AIGC Translation Practice Process and Effect Verification

This study selects Yueqing boxwood carving as the empirical object, and carries out a full-process experiment from basic data construction to product implementation based on the previously constructed "four-dimensional closed-loop innovation framework", aiming to verify the effectiveness of AIGC technology in the visual translation of traditional crafts.

4.1. Practical Preparation: Data Asset Construction and Constraint Mechanism

Before the start of the experiment, the primary task of the team is to transform ICH entities into high-quality data assets recognizable by computers. Firstly, a standardized visual sample library is established. Digitization collection is carried out for more than 100 master-level boxwood carving works in accordance with a unified light environment and macro perspective, not only recording the overall form, but also retaining close-ups of knife rhythm and wood texture. On this basis, an "image-text" aligned semantic tag system is constructed, converting abstract ICH aesthetic concepts such as "warm and moist" and "simple and unsophisticated" into light and shadow parameters and material keywords understandable by AI, and clearly setting a "negative constraint list" including costume form errors and plastic texture, so as to avoid cultural distortion of generated results from the source.

4.2. Module Implementation: Phased Advancement of the Four-Dimensional Framework

In the cultural decoding stage, through in-depth cooperation with ICH inheritors, the team extracts core visual genes such as "boxwood water patterns" and "pleated streamlines", and constructs an exclusive "style dictionary" to ensure that the underlying logic of AI generation conforms to traditional craft norms. Entering the core AIGC translation stage, the study focuses on solving the controllability problem: on the one hand, using ControlNet technology to extract the line draft skeleton of traditional statues, strictly restricting the physical structure and proportion of generated images to avoid modeling collapse; on the other hand, training an exclusive boxwood carving LoRA model to forcefully inject delicate wood grain texture and patina luster, and using local redrawing technology to perform pixel-level refinement on details such as facial features and hands, realizing the precise transformation from sketch to high-fidelity visual scheme.

In the creative design and industrial empowerment stage, designers select high-quality generated schemes and transform them into three major product series: desktop Zen ornaments, lightweight cultural tourism gifts and modern home wall decorations. During implementation, the "CNC rough processing + manual refinement" mode is adopted for high-end products, and wood powder 3D printing technology is explored for mass products to control costs. At the same time, digital communication is carried out by making short videos and AR interactive content with scene graphs generated by AI, and finally the complete closed loop from design drawings to commercial products is realized.

4.3. Practical Effects and Evaluation

This study has collected more than 500 research data, constructed more than 2000 effective visual assets, and successfully incubated 12 physical products. Through comprehensive evaluation from multiple dimensions of authenticity, marketability and user end, the innovative model has achieved remarkable results: ICH inheritors recognize that the AI-generated schemes accurately reproduce the core knife logic and artistic charm of boxwood carving; cooperative enterprises feedback that the new process has

reduced the R&D cycle by more than half, and the production cost of the desktop small product series has decreased by about 60%; the "new ICH" products with both traditional heritage and modern aesthetics have gained wide favor among young consumer groups. It fully confirms the practical value of this path in improving the development efficiency of ICH cultural and creative products and optimizing product quality.

5. Reflections and Optimization Directions

5.1. Key Challenges and Limitations

This study introduces Nano Banana Pro for the visual translation practice of boxwood carving. While significantly improving the efficiency of design iteration, it also exposes two core limitations: "cultural semantic drift" and "process implementation gap". On the one hand, the "average face" effect of the AIGC model makes the generated results prone to fall into the aesthetic rut of "generalized national style", and it is difficult to accurately restore the ontological characteristics of Yueqing boxwood carving such as "round knife techniques and expressing spirit through form", leading to the distortion of theme connotations and process logic. On the other hand, the "high visual fidelity" of virtual images often conceals the complexity of physical manufacturing. Some generated schemes cannot be directly restored through CNC or manual work in terms of structural strength and pattern density, and there are still blind spots in the collection, confirmation and compliance of sample data, which restricts the stability of industrial transformation.

5.2. Optimization Strategies

To address the above problems, future research should first establish a standardized ICH visual asset ontology library. By formulating strict image collection specifications and multi-dimensional tag systems (theme-structure-pattern), combined with the prompt template and preset parameter management functions of Nano Banana Pro, the random deviation of algorithm generation is converged to the greatest extent, and the stability of output is improved.

More importantly, it is necessary to establish a constraint mechanism of "manufacturability pre-positioning", set process thresholds such as openwork hole positions and thin-walled thickness at the generation end, and reversely correct the generation strategy through proofing feedback. At the same time, establish a deep co-creation paradigm of "inheritors-algorithms", transforming inheritors from simple "auditors" into full-process "co-authors" to control cultural boundaries and key details.

6. Conclusion

In general, AIGC is not a substitute for traditional handicrafts, but a new medium that translates their "craft language" into communicable and systematic forms. On the premise of adhering to cultural authenticity and improving the collaborative mechanism of "inheritors-designers-enterprises-platforms", with the help of the powerful generation and editing capabilities of Nano Banana Pro, Yueqing boxwood carving has successfully broken through the single display logic and constructed a full-link product system covering physical products, digital content and packaging materials. This deep integration of "craft + algorithm" not only retains the cultural core and manual temperature of ICH, but also endows it with innovative vitality adapting to the modern market. It builds a new connection bridge for traditional ICH to integrate into contemporary life, helping it truly realize the modern rebirth from "museum display" to "carrier of lifestyle", and also provides a replicable practical sample for the digital transformation of similar ICH techniques.

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